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RESEARCH METHODOLOGY: INSTRUMENT DEVELOPMENT

Measuring hospital staff nurses perception on quality of the professional practice environment

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Abstract

Aim. The purpose of this study was to determine construct validity of the Dutch Essentials of Magnetism II © instrument, designed to assess nursing practice environments, using hypotheses testing.

Background. Reduction in hospital length of stay and the number of inpatient beds increases care intensity. Educational levels and numbers of nursing staff in hospitals, however, do not match this increase, resulting in a strain on quality of care and patient safety. A possible answer to existing concerns about quality of care may be the creation of a productive and healthy practice environment, as this has an impact on the quality of care. Therefore, areas requiring improvement of the practice environment have to be defined.

Design. A cross-sectional, correlational study design.

Method. We determined construct validity with hypotheses testing by relating the Dutch Essentials of Magnetism II to the Dutch Practice Environment Scale of the Nursing Work Index. We formulated 15 hypotheses prior to data-analysis; 10 related to convergent validity and five related to discriminant validity. Data were collected from qualified nurses ($N = 259$) on nine randomly selected hospital wards from March to April 2012.

Results. Response rate was 47% ($n = 121$). Total scores of both instruments are strongly correlated ($r = 0{\cdot}88$). In total, 12 of 15 hypotheses (80%) were confirmed and three were rejected.

Conclusion. The D-EOMII has satisfactory construct validity for measuring the nursing practice environment in hospitals and can be used by nurses, managers, health policy makers, hospitals and governments to assess and identify processes and relationships that are in need of improvement.

Keywords: hospital care, hypotheses testing, nursing, practice environment, quality of care, workforce issues

Why is this research needed?

- Reduction in hospital length of stay and the number of inpatient beds increase care intensity for inpatients.
- The numbers and educational levels of nursing staff in hospitals do not match this increase in care intensity, resulting in a strain on quality of care and patient safety.
- Existing concerns about quality of care may be overcome by creating optimal practice environments for nurses and therefore areas of improvement have to be defined, requiring valid and reliable measures.
- The Essentials of Magnetism II is not extensively evaluated outside its original context of USA-based hospitals. Yet, such evaluations are necessary if we reliably want to assess the practice environment.

What are the key findings?

- The Dutch Essentials of Magnetism instrument has satisfactory construct validity for measuring the nursing practice environment in hospitals.
- Subscales of the Dutch Essentials of Magnetism instrument and the Practice Environment Scale of the Nursing Work Index are correlated, but not highly correlated, thus indicating that subscales do not measure the exact same constructs.

How should the findings be used to influence policy/practice/research/education?

- The Dutch Essentials of Magnetism instrument can be used to assess nursing practice environments in hospitals and to identify processes and relationships that are in need of improvement.
- A nursing practice environment that encompasses the essential elements measured by the D-EOMII, can help to attract and retain well qualified nurses.
- This study indicates that the Dutch Essentials of Magnetism and the Practice Environment Scale of the Nursing Work Index vary in measured constructs but, given the large overlap in what is captured, using both instruments is not worthwhile.
- Nursing education should include the essentials of magnetism as nurses need to know which elements enable them to deliver the best possible patient care.
- Further research is recommended to get insight about elements of the nursing practice environment are most strongly related to the quality of patient care.

Introduction

The financial crisis in Europe resulted in constraints on health expenditure growth leading to, for instance, internal hospital restructuring and cutting costs (Karanikolos *et al.* 2013). Reduction in hospital length of stay and the number of inpatient beds increases care intensity for inpatients (Aiken *et al.* 2013, 2014). At the same time, there is no matching increase in either the numbers or educational levels of nursing staff in hospitals, resulting in a strain on quality of care and patient safety (Aiken *et al.* 2014).

The Organisation for Economic Co-operation and Development (OECD) reported that many European countries face shortages of nurses and the nursing workforce is ageing (OECD 2012). Therefore, it is also not possible to simply increase the number and educational level of nursing staff. Studies indicated that better practice environments in hospitals are significantly associated with better quality and safety of patient care and higher job satisfaction for nurses (Zangaro & Soeken 2007, Cheung *et al.* 2008, Duvall & Andrews 2010, Bae 2011, Aiken *et al.* 2012, 2014, Djukic *et al.* 2013). Optimally designed practice environments support nurses' delivery of care, enabling them to sustain or improve quality of patient care (Djukic *et al.* 2013). Furthermore, Aiken *et al.* (2012) noted that creating an optimal practice environment can be a relatively low cost strategy. Thus, a possible answer to the existing concerns on quality of care may be the creation of a productive and healthy practice environment for nurses.

To be able to establish an optimal practice environment, areas of improvement have to be defined (Warshawsky & Havens 2011). For this, managers in healthcare organizations need valid and reliable assessment tools to identify weaknesses and key strengths in their nurses' practice environments (Lake 2007).

Organizational traits relevant for nurses' practice environment were identified by the American Academy of Nursing in several projects on the identification of 'excellent hospitals' with professionally and personally rewarding nursing practice environments; so-called Magnet Hospitals (McClure *et al.* 1983). An instrument was developed to measure eight attributes of the nursing practice environment defined by Magnet Hospital nurses as essential to quality care: the Essentials of Magnetism II© (EOMII) (Health Sciences Research Associates (HSRA), California). To be able to implement improvements in the work environment that lead to improved patient outcomes, measurement of processes in terms of steps and components of the nursing practice environment should be performed at nursing ward level as patients on different ward have specific characteristics and needs that require different nursing care (Kramer *et al.* 2014). The EOMII does measure steps and components of the nursing practice environment on ward level

and focusses on contributing elements of the practice environment to quality of care. This is exactly the wanted combination for this study. In the Netherlands, no process measurement of the nursing practice environment existed and therefore the EOMII was translated and tested in Dutch hospitals (De Brouwer *et al.* 2014). However, further validation was suggested by De Brouwer *et al.* 2014.

Background

The Essentials of Magnetism II© (EOMII) is a globally used instrument measuring processes and relationships of practice environment contributing to productivity and quality of patient care (Schmalenberg & Kramer 2008). The EOMII measures functional processes leading to desired patient and nurse outcomes, called Essentials of Magnetism (EOM): Collaborative Nurse-Physician Relationships, Control over Nursing Practice, Nurse Manager Support, Adequacy of Staffing, Clinically Competent Peers, Support for Education, Patient Centred Culture, Clinical Autonomy (Schmalenberg & Kramer 2008, De Brouwer *et al.* 2014).

De Brouwer *et al.* 2014 translated the EOMII into Dutch (D-EOMII) and showed acceptable reliability and validity. However, to ensure the D-EOMII is a valid and reliable measure the validation process should be amplified (De Brouwer *et al.* 2014). Further insight in the D-EOMII's construct validity is necessary in this validation process.

Construct validity refers to the extent to which scores of a questionnaire relate to other measures in a manner that is consistent with theoretically derived hypotheses concerning the concepts that are being measured (Mokkink *et al.* 2010). Construct validity can be determined in terms of structural validity (degree to which questionnaire scores are an adequate reflection of the dimensionality of the construct), cross-cultural validity (degree to which performance of items of a translated instrument are an adequate reflection of that of the original version) and hypotheses testing (correlation between measures or expected differences in scores between 'known' groups) (Mokkink *et al.* 2010).

Structural validity and cross-cultural validity have already been addressed for the D-EOMII (De Brouwer *et al.* 2014). However, hypotheses testing has not yet been done.

In hypotheses testing, formulation of hypotheses, specified in advance, is important to overcome the risk of bias in determining whether the instrument is valid (Terwee *et al.* 2007). A positive rating for construct validity can be determined when at least 75% of the results are in correspondence with the hypotheses in (sub)groups of at least 50 respondents. Hypotheses testing can be split into testing for convergent (degree to which measures of constructs that theoretically should be related to each other are correlated) and discriminant (degree to which measures of constructs that theoretically should not be related to each other are correlated) validity (Elbers *et al.* 2012).

To be able to test the convergent validity, we need to have measures of construct(s) that are theoretically related to the constructs measured with the D-EOMII. Several instruments have been developed to measure nurses' assessment of their practice environment. One example is the Practice Environment Scale of the Nurse Work Index-Revised (PES- NWI), which is a second globally used instrument measuring contributing elements of the practice environment to nursing job satisfaction (Lake 2002, Warshawsky & Havens 2011). The PES-NWI and the D-EOMII have a common ancestor, the Nursing Work Index (NWI), but the focus of both instruments differs to some extent due to a focus on structures facilitating a good work environment (PES-NWI) vs. actual processes in this work environment (EOMII) (Lake 2002, Schmalenberg & Kramer 2008, Kramer *et al.* 2014).

To date, no publication is found on validity and reliability of the Dutch PES-NWI in the Netherlands. However, there is a Dutch version available, tested in Belgian hospitals, with a structure that differs from the original PES-NWI. Cronbach's alpha coefficients of the three subscales of that version are 0·80 or higher (Van Bogaert *et al.* 2009). Nevertheless, in the 'RN4Cast' study, the original version is used in the Netherlands including 5 subscales (Sermeus *et al.* 2011) (Table 1). The reliability, in terms of Cronbach's alpha coefficients of the original (English language) PES-NWI subscales, ranges from 0·71–0·84 (Lake 2002). Predictive validity estimates of the subscales for personnel stability and quality of hospital care are high (Aiken *et al.* 2008, Bruyneel *et al.* 2009). The use of the instrument was reviewed by Warshawsky and Havens (2011) and they concluded that the PES-NWI can be used to assess the nursing practice environment. Lake (2007) compared the PES-NWI with other measures of the nursing practice environment and defined the PES-NWI as the most useful instrument in comparison with the Nursing Work Index (Kramer & Hafner 1989), Revised Nursing Work Index (Aiken & Patrician 2000), Work Environment Scale (Moos & Insel 1994), Job Characteristics inventory (Sims *et al.* 1976), Ward Organization Features Scale (Adams *et al.* 1995), Work Quality Index (Whitley & Putzier 1994) and the Assessment of Work Environment Schedule (Nolan *et al.* 1998). Thus, although validity of the Dutch version of the PES-NWI is strictly not evaluated in the Netherlands, the PES-NWI was chosen as a useful measure to determine the construct validity of the D-EOMII.

Table 1 Subscales of the EOMII and PES-NWI, number of items, Cronbach's α.

EOMII subscale (no. items, α*)	PES-NWI subscale (no items†)
Collaborative nurse–physician relationships (6, 0·79)	Collegial nurse-physician relationships (7, 0·88)
Control over nursing practice (8, 0·75)	Nurse involvement in hospital affairs (8, 0·77)
Nurse manager support (10, 0·92)	Nurse manager qualities (4, 0·82)
Adequacy of staffing (6, 0·83)	Adequacy of staffing and resources (4, 0·77)
Clinically competent peers (4, 0·55)	Item: Working with nurses who are clinically competent (Nursing Foundations for Quality of Care)
Support for education (4, 0·37)	Adequacy of staffing and resources (4)Item: Active staff development or continuing education programmes for nurses (Nursing Foundations for Quality of Care)
Patient centred culture (11, 0·85)	Item: A clear philosophy of nursing that pervades the patient care environment (Nursing Foundations for Quality of Care)
Item: Inter- and intra-disciplinairy teamwork (Patient Centered Culture)	Item: Enough time and opportunity for team consultation (Adequacy of Staffing and Resources)
Clinical autonomy (9, 0·72)	Nursing foundations for quality of care (9, 0·69)

*De Brouwer *et al.* (2014).
†α of the Dutch PES-NWI based on data from this study.

The study

Aim

The aim of this study was to determine construct validity of the D-EOMII, using hypotheses testing including a comparison of the Dutch PES-NWI and the D-EOMII.

Sample

The D-EOMII and PES-NWI were administered at nine randomly selected wards of a Dutch general hospital between March and April 2012. Nurses' participation was voluntary. After obtaining nurses' consent, all data were treated confidentially and anonymously.

Qualified nurses with educational levels varying from associate to bachelor degree (4 years of training) employed by the hospital, independent of their contract, gender, education, years of employment and age, were included if they worked on the ward for more than 6 months ($N = 259$). We excluded nurse assistants, nurse managers, nurses with a merely administrative position and interns/students.

Instruments

D-EOMII consists of 58 items and eight constructs (Table 1) defined as functional processes leading to desired patient and nurse outcomes, called Essentials of Magnetism (EOM): Collaborative Nurse-Physician Relationships, Control over Nursing Practice, Nurse Manager Support, Adequacy of Staffing, Clinically Competent Peers, Support for Education, Patient Centred Culture, Clinical Autonomy (Schmalenberg & Kramer 2008, De Brouwer *et al.* 2014). We used the Dutch version of the EOMII (D-EOMII). Before using this instrument, adjustments were made as suggested by De Brouwer *et al.* (2014). No items were removed. Items of subscales Collaborative Nurse-Physician Relationships (five items,), Support for Education (one item) and Clinically Competent Peers (four items) have been shortened and simplified. Item 52 has been adjusted from high performance and productivity to high performance and good work ethic as productivity had a different connotation in the Netherlands as referred to in the original EOMII (De Brouwer *et al.* 2014). Permission of HSRA was obtained to reprint the original Essentials of Magnetism Scale.

The PES-NWI consists of 32 items and five subscales: Nurse Manager Qualities, Collegial Nurse-Physician Relationships, Nurse Involvement in Hospital Affairs, Nursing Foundations for Quality of Care, Adequacy of Staffing and Resources (Table 1) (Lake 2002).

Both instruments target the hospital staff nurses. All participants who met the inclusion criteria received an instruction letter explaining the purpose of the research, duration of participation and a description of procedures. Participants were informed that results would be used for scientific research only and that none of the data would be reported at the level of individuals.

The instruments were administered via a mailed survey. For both instruments respondents rate each item on a 4-point Likert scale, ranging from 1 (strongly disagree) – 4 (strongly agree), to indicate whether the item is present in

their current practice environment (Lake 2002, Schmalenberg & Kramer 2008).

Ethical considerations

No approval of an ethics committee was necessary as patient care was not affected or changed in any way and individuals were not subjected to invasive or laborious regimes, which is in line with Dutch law (CCMO 2011). All participants were informed verbally and via an instruction letter. Those who did not wish to take part did not return their questionnaires.

Methodology

We used a cross-sectional, correlational study design comparing results of the PES-NWI and the D-EOMII. We administered the D-EOMII in the hospital setting via a web application.

Hypotheses testing

We formulated 15 hypotheses prior to data-analysis.

Convergent validity

Ten hypotheses were formulated with regard to convergent validity (Table 2). The first concerned the degree to which the measures total D-EOMII score and total PES-NWI scores are correlated. It was hypothesized that the total D-EOMII score is very strongly ($r > 0{\cdot}80$) correlated with the total PES-NWI score as both instruments measure perception of the practice environment (hypothesis 1). Furthermore, three subscales of both instruments measure the same construct, namely Nurse-Physician Relationship, Control over Nursing Practice and Nurse Manager Support (Table 1). The D-EOMII subscale measures collaborative nurse–physician relationships, whereas the PES-NWI measures collegial nurse-physician relationships. Therefore, it was hypothesized that the correlation between subscale sum scores of both instruments concerning the nurse-physician relationship is strong ($r > 0{\cdot}50$) but not above $r = 0{\cdot}80$ (hypothesis 2). Control over Nursing Practice, a subscale of the D-EOMII, is hypothesized to correlate strongly ($r > 0{\cdot}50$) with Nurse Involvement in Hospital Affairs of the PES-NWI. Most items of the D-EOMII's subscale are included in Nurse Involvement in Hospital Affairs. However, both subscales also differ at item level. Therefore, we hypothesized that the correlation between subscale sum scores of both instruments is strong ($r > 0{\cdot}50$) but not above $r = 0{\cdot}80$ (hypothesis 3). The D-EOMII subscale Nurse Manager Support and the PES-NWI subscale Nurse Manager Qualities is hypothesized to correlate very strongly ($r = 0{\cdot}80$) with each other as both constructs are very similar (hypothesis 4).

D-EOMII subscale sum score of Adequacy of Staffing is hypothesized to correlate strongly ($r > 0{\cdot}50$) to the PES-NWI subscale sum score of Adequacy of Staffing and Resources (hypothesis 5) as three of the four items of the PES-NWI subscale measure the same elements as the D-EOMII subscale. The PES-NWI subscale Adequacy of Staffing and Resources contains one item about teamwork, which is also embedded in the D-EOMII subscale Patient Centered Culture. Therefore, the D-EOMII subscale Patient Centered Culture is hypothesized to correlate moderately

Table 2 Hypotheses.

1	Very strong correlation* between total D-EOMII score and total PES-NWI score
2	Strong correlation Collaborative Nurse–Physician Relationships and Collegial Nurse-Physician Relationships
3	Strong correlation between Control over Nursing Practice and Nurse Involvement in Hospital Affairs
4	Very strong correlation between Nurse Manager Support and Nurse Manager Qualities
5	Strong correlation between Adequacy of Staffing and Adequacy of Staffing and Resources
6	Moderate correlation between Adequacy of Staffing and Resources and Patient Centered Culture
7	Moderate correlation between Nursing Foundations for Quality of Care and Clinically Competent Peers
8	Moderate correlation between Nursing Foundations for Quality of Care and Support for Education
9	Moderate correlation between Nursing Foundations for Quality of Care and Patient Centered Culture
10	Strong correlation between mean total ward scores on D-EOMII and PES-NWI
11	Collaborative Nurse–Physician Relationships correlates less with other subscales of the PES-NWI than with Collegial Nurse-Physician Relationships
12	Control over Nursing Practice correlates less with other subscales of the PES-NWI than with Nurse Involvement in Hospital Affairs
13	D-EOMII subscale Nurse Manager Support correlates less with other subscales of the PES-NWI than with Nurse Manager Qualities
14	D-EOMII subscale Adequacy of Staffing correlates less with other PES-NWI subscales than with Adequacy of Staffing and Resources
15	PES-NWI subscale Adequacy of Staffing and Resources correlates less with other D-EOMII subscales than with Patient Centered Culture, except from Adequacy of Staffing

*Correlation: <0·30 weak, 0·30–0·50 moderate, 0·50–0·80 strong, and >0·80 very strong.

($r > 0{\cdot}30$) with the PES-NWI subscale Adequacy of Staffing and Resources (hypothesis 6).

The PES-NWI subscale Nursing Foundations for Quality of Care contains elements of D-EOMII's subscales Clinically Competent Peers, Support for Education and Patient Centred Culture. We hypothesized that correlations between the subscale sum score of Nursing Foundations for Quality of Care correlates moderately ($r > 0{\cdot}30$) with sum scores of Clinically Competent Peers, Support for Education and Patient Centred Culture (hypotheses 7–9).

As both questionnaires aim to measure the work environment on ward level, we finally hypothesized that wards with a high score on the D-EOMII would also score high (correlation of ranking $\rho > 0{\cdot}50$) on the PES-NWI (hypothesis 10).

Discriminant validity

Five hypotheses were formulated with regard to discriminant validity: The D-EOMII subscale Collaborative Nurse–Physician Relationships correlates less ($r < 0{\cdot}74$) with other subscales of the PES-NWI than with Collegial Nurse-Physician Relationships (hypothesis 11); D-EOMII subscale Control over Nursing Practice correlates less ($r < 0{\cdot}44$) with other subscales of the PES-NWI than with Nurse Involvement in Hospital Affairs (hypothesis 12); D-EOMII subscale Nurse Manager Support correlates less ($r < 0{\cdot}80$) with other subscales of the PES-NWI than with Nurse Manager Qualities (hypothesis 13). D-EOMII subscale Adequacy of Staffing correlates less ($r < 0{\cdot}30$) with other PES-NWI subscales than with PES-NWI subscale Adequacy of Staffing and Resources (hypothesis 14). PES-NWI subscale Adequacy of Staffing and Resources correlates less ($r < 0{\cdot}49$) with other D-EOMII subscales than with D-EOMII subscale Patient Centered Culture, except for D-EOMII subscale Adequacy of Staffing (hypothesis 15).

Data analysis

In line with the standard methods of HSRA, the institute that developed the EOMII, only sufficiently completed questionnaires were included, meaning that respondents with more than 25% missing items on two or more subscales were excluded from this study.

All hypotheses, except for hypothesis 10, were tested calculating Pearson correlation coefficients, r, as we are analysing instruments that supposedly measure similar constructs. In these analyses, we used individual respondent scores on both instruments. We checked for potential clustering of nurse data at the level of wards by calculating Spearman's correlation coefficient, ρ, on ward averages. For hypothesis 10, we rank ordered wards' mean scores, derived from individual scores, on the total D-EOMII score and the total PES-NWI score and tested the hypothesis by calculating Spearman's correlation coefficient, ρ. This limits the random effects due to clustering of data in wards.

Sample size for hypotheses testing was considered adequate if $N > 100$ (Mokkink *et al.* 2010). In all hypotheses, we used a one-tailed test with the following criteria: correlation coefficients <0·30 indicate weak correlations, 0·30–0·50 imply moderate correlations, 0·50–0·80 represent strong correlations and >0·80 are very strong correlations (Nunnally & Bernstein 1994, De Vet *et al.* 2011).

Construct validity was determined to be present if at least 75% of the results were in correspondence with the predefined hypotheses, thus for 11 of the 15 hypothesis (De Vet *et al.* 2011). However, hypothesis 1 was considered most important. If hypothesis 1 were to be rejected, it would indicate that the PES-NWI and the D-EOMII scores are not related and therefore further results on the hypothesis testing would not be as relevant.

Results

Sample

Nine different nursing wards participated: internal medicine, paediatric medicine, neurology, cardiology, short stay surgery, gastroenterology and hepatology, neonatology, geriatrics and renal dialysis. A total of 158 (61% of $n = 259$) questionnaires were returned of which 37 were not sufficiently completed and therefore excluded. Respondents' ($n = 121$, 47%) age varied from 19-63 years with an average of 38·9 years. Most respondents were females (95·6%). The majority worked part time (45·6%). A third of the respondents had zero to 5 years of work experience (33·9%). Of the respondents, 29·8% had a bachelor degree in nursing (Table 3).

Hypotheses testing

Hypothesis 1 was confirmed (Table 4 for all subscale correlations) as the total D-EOMII score and total PES-NWI score were strongly correlated ($r = 0{\cdot}88$). Hypotheses 2 and 4 were confirmed as Collaborative Nurse–Physician Relationships and Collegial Nurse-Physician Relationships were significantly and strongly correlated ($r = 0{\cdot}74$), as well as Nurse Manager Support and Nurse Manager Qualities ($r = 0{\cdot}81$). However, hypothesis 3 was rejected as Control

Table 3 Respondents' characteristics (n = 121).

Demographics	
Age (years) (Mean; SD)	38·9; 12·2
Sex (%; n) – Women	95·8; 114
Contract (%; n) – full time	44·6; 54
Work experience (Mean; SD)	14·3; 11·1
Work experience (%; n)	
0–5 years	33·9; 40
6–10 years	12·7; 15
11–15 years	11·0; 13
16–20 years	12·7; 15
21–25 years	9·3; 11
26–30 years	8·5; 10
>30 years	11·9; 14
Bachelor's degree in nursing (%; n)	29·8; 36

over Nursing Practice and Nurse Involvement in Hospital Affairs were significantly correlated but only moderately (r = 0·44).

Hypotheses 5 and 6 were confirmed as Adequacy of Staffing and Resources and Adequacy of Staffing were strongly correlated (r = 0·73) and Adequacy of Staffing and Resources and Patient Centered Culture were moderately correlated (r = 0·49). Nursing Foundations for Quality of Care was moderately correlated with Clinically Competent Peers (r = 0·44), Support for Education (r = 0·46) and Patient Centred Culture (r = 0·63), therefore, hypotheses 7–9 were confirmed. Hypothesis 10 was confirmed as mean total scores of the wards on both instruments correlated strongly (ρ = 0·83, P = 0·003).

Hypothesis 11 was confirmed as other subscales of the PES-NWI were only low to moderately correlated (r ranged from 0·29–0·46) to Collegial Nurse-Physician Relationships. Hypothesis 12 was rejected as Control over Nursing Practice was more strongly correlated with Nursing Foundations for Quality of Care and Adequacy of Staffing and Resources, although Control over Nursing Practice did correlate less with Collegial Nurse-Physician Relationships and Nurse Manager Qualities. Hypothesis 13 was confirmed as the other subscales were correlated less with Nurse Manager Support ($r \leq$ 0·66) than with Nurse Manager Qualities (r = 0·81). Hypothesis 14 was confirmed as subscale Adequacy of Staffing and Resources correlates strongly (r = 0·73) to Adequacy of Staffing and low to moderately with the other D-EOMII subscales ($r \leq$ 0·49) (hypothesis 14). Hypothesis 15 was also confirmed as all other D-EOMII subscales, except for Adequacy of Staffing, correlate less with the PES-NWI subscale Adequacy of Staffing and Resources.

In total, 13 of the 15 hypotheses (87%) were confirmed. The check for clustering generated the same results except for hypothesis 11. The analyses showed that the PES-NWI subscale Nurse Manager Qualities was more strongly correlated with the D-EOMII subscale Collaborative Nurse–Physician Relationships, which was not the case in the analyses on individual respondent scores.

Discussion

The aim of this study was to determine construct validity of the D-EOMII, using hypotheses testing. Results of our study showed that 87% of the tested hypotheses were confirmed. Therefore, we conclude that the D-EOMII has satisfactory construct validity. Total scores on both D-EOMII as PES-NWI are strongly correlated as expected, which means that an organization scoring high on one of the two instruments will also score high on the other.

Correlations between subscales of both instruments are not so high that subscales measure the exact same constructs as none of the subscale correlations approaches 1 (all subscale correlations are significant but smaller than r = 0·82). If we, for instance, look at the subscales Collaborative Nurse-Physician Relationships (D-EOMII) and Collegial Nurse-Physician Relationships (PES-NWI) we see that r = 0·74, thus indicating some variation in what is assessed. Looking at the items of both instruments it seems that the PES-NWI measures the level of satisfaction on the nurse-physician relationship, whereas the D-EOMII measures the type of nurse-physician relationship that is present.

Two hypotheses were rejected. First, we expected a strong correlation between the subscales Control over Nursing Practice (D-EOMII) and Nurse Involvement in Hospital Affairs (PES-NWI). The correlation was r = 0·44, however, which indicates a moderate correlation. Second, we expected that Control over Nursing Practice (D-EOMII) would correlate less with other subscales of the PES-NWI than with Nurse Involvement in Hospital Affairs. We found, however, that Nursing Foundations for Quality of Care and Adequacy of Staffing and Resources of the PES-NWI correlated more strongly. Based on the content of both subscales, this can be explained by the fact that Nurse Involvement in Hospital Affairs contains two items concerning the presence of a Chief Nursing Officer (CNO). This position does not exist in Dutch hospitals and can therefore lead to a wrongful score on this subscale. The CNO is not an aspect in the D-EOMII. Therefore, use of the D-EOMII rather than the PES-NWI could be more suitable in the Dutch situation. An earlier study on the

Table 4 Correlations between EOMII subscales and PES-NWI in Pearson *r*.

	PES-NWI					
EOMII	Staffing and resource adequacy	Collegial nurse-physician relationships	Nurse manager ability, leadership, support of nurses	Nurse involvement hospital affairs	Nursing foundations for quality of care	Total score
Perceived adequacy of staffing						
Correlation Coefficient *r*	0·728*	0·379*	0·496*	0·503*	0·378*	0·620*
P-value (1-tailed)	<0·001	<0·001	<0·001	<0·001	<0·001	<0·001
N	116	114	109	112	103	99
Clinically competent peers						
Correlation Coefficient *r*	0·376*	0·287*	0·521*	0·565*	0·442*	0·557*
P-value (1-tailed)	<0·001	0·001	<0·001	<0·001	<0·001	<0·001
N	121	119	114	116	108	103
Nurse manager support						
Correlation Coefficient *r*	0·455*	0·343*	0·813*	0·658*	0·612*	0·726*
P-value (1-tailed)	<0·001	<0·001	<0·001	<0·001	<0·001	<0·001
N	117	115	111	114	106	102
Patient centred culture						
Correlation Coefficient *r*	0·486*	0·510*	0·624*	0·746*	0·634*	0·786*
P-value (1-tailed)	<0·001	<0·001	<0·001	<0·001	<0·001	<0·001
N	118	117	111	113	107	102
Control over nursing practice						
Correlation Coefficient *r*	0·452*	0·277*	0·403*	0·435*	0·569*	0·546*
P-value (1-tailed)	<0·001	0·001	<0·001	<0·001	<0·001	<0·001
N	116	114	111	112	105	100
Clinical autonomy						
Correlation Coefficient *r*	0·404*	0·386*	0·525*	0·373*	0·489*	0·531*
P-value (1-tailed)	<0·001	<0·001	<0·001	<0·001	<0·001	<0·001
N	113	111	108	108	103	98
Collaborative nurse-physician relationships						
Correlation Coefficient *r*	0·437*	0·743*	0·455*	0·315*	0·293*	0·563*
P-value (1-tailed)	<0·001	<0·001	<0·001	<0·001	0·001	<0·001
N	120	118	113	115	107	102
Support for education						
Correlation Coefficient *r*	0·232*	0·266*	0·512*	0·428*	0·461*	0·508*
P-value (1-tailed)	0·005	0·002	<0·001	<0·001	<0·001	<0·001
N	120	118	113	115	107	102
Total EOMII score						
Correlation Coefficient *r*	0·661*	0·565*	0·805*	0·735*	0·710*	0·881*
P-value (1-tailed)	<0·001	<0·001	<0·001	<0·001	<0·001	<0·001
N	100	99	96	97	93	89

*Correlation is significant at the 0·01 level (1-tailed).

D-EOMII also showed that Control over Nursing Practice is a reliable subscale, which showed good estimates of face and content validity (De Brouwer *et al.* 2014).

Confirmation of the hypotheses indicates that the D-EOMII can be used to identify areas of improvement in the nursing practice environment. Although the D-EOMII and the PES-NWI both focus on the nursing practice environment and the correlations between both instruments are largely in accordance with what we hypothesized, this study also indicates that the individual instruments do vary in constructs being measured with their subscales with subscale correlations below 0·82. Yet using both instruments is not recommended, because sum scores on both instruments are strongly correlated indicating a positive score on one instrument also leads to a high score on the other instrument. Depending on the learning objective of the organization or ward it is useful to see which instrument would fit best. The EOMII encompasses elements that are not present in the PES-NWI and gives a more thorough insight in areas of improvement in the nursing practice

environment. Also, the PES-NWI encompasses an element that is not relevant for the Dutch healthcare system: presence of a Chief Nursing Officer. However, the PES-NWI is a shorter questionnaire which is therefore less of a burden to administer.

Limitations

One could argue that a limitation of this study is that we included only one hospital. Yet for this type of study, where results of two instruments are compared and not organizations or wards, a multi-centre study is not as necessary. We wanted to study the construct validity of the D-EOMII by analysing correlations between D-EOMII and another scale that presumes to measure corresponding constructs. To answer this question with hypotheses testing individual scores of nurses can be used to test the hypotheses. Ideally, more clusters should have been included in this study to optimally account for the effect of clustering of the data. To assess to what level this could have been problematic, we also checked all our hypotheses on the basis of rank ordering mean scores at ward level and found the same results except for one hypothesis. This indicates that conclusions would not be very different and therefore the individual scores can be used.

Hypotheses were stated as specific as possible including the magnitude of the expected correlation, which is a strength of this study (De Vet *et al.* 2011).

Finally, it can be questioned whether the PES-NWI is the best reference instrument for evaluation the validity of the EOMII. We chose to use the PES-NWI as a good translation of the instrument was available. Yet, no studies were found on the validity or reliability of the Dutch version of the PES-NWI, for which we had to refer to international literature. According to Lake's comparison of measures (2007), however, the PES-NWI is considered the most useful instrument for determining the construct validity of the D-EOMII.

Conclusion

We provided evidence that the D-EOMII has satisfactory construct validity for measuring the nursing practice environment. The EOMII is widely used to identify areas of improvement in the nursing practice environment. This study contributes to the body of knowledge on the construct validity of the D-EOMII and outside the USA-context of its development. The D-EOMII can be used by nurses, managers, health policy makers, hospitals and even governments to assess nursing practice environments and to identify processes and relationships that are in need of improvement. A nursing practice environment that positively encompasses the essential elements measured by the D-EOMII, can help to attract and retain well qualified nurses, as indicated by several studies (Kramer & Schmalenberg 2002, Schmalenberg & Kramer 2008, Bai *et al.* 2015). Given the discrepancy between the increasing care intensity in hospitals and the quality and quantity of nursing staff, creating excellent nursing practice environments is of great importance. Hospital managers can use the instrument to assess their work environment for nursing staff and receive feedback on possibilities for improvement. The essentials of magnetism are recommended to be included in the curricula of nursing education as nurses need to know which elements enable them to deliver the best possible patient care.

Research, including this study, supports the validity of the D-EOMII valid measure of the nursing practice environment. Further research is recommended to investigate which elements of the nursing practice environment are most strongly related to the quality of patient care and which effect sizes on the instrument can be expected as a result of actions taken to improve the work environment.

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Conflict of interest

This research was formed without any financial support and any conflict of interest. Copyright on the original Essentials of Magnetism instrument means that this instrument cannot be reprinted without the expressed written permission of Health Sciences Research Associates and, therefore, permission was obtained.

Author contributions

All authors have agreed on the final version and meet at least one of the following criteria [recommended by the ICMJE (http://www.icmje.org/recommendations/)]:

- substantial contributions to conception and design, acquisition of data or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

References

Adams A., Bond S. & Arber S. (1995) Development and validation of scales to measure organisational features of acute hospital wards. *International Journal of Nursing Studies* **32**(6), 612–627.

Aiken L.H. & Patrician P.A. (2000) Measuring organizational traits of hospitals: the revised nursing work index. *Nursing Research* **49**(3), 146–153.

Aiken L.H., Clarke S.P., Sloane D.M., Lake E.T. & Cheney T. (2008) Effects of hospital care environment on patient mortality and nurse outcomes. *Journal of Nursing Administration* **38**, 223–229.

Aiken L.H., Sermeus W., Van den Heede K., Sloan D.M., Busse R., McKee M., Bruyneel L., Rafferty A.M., Griffiths P., Moreno-Casbas M.T., Tishelman C., Scott A., Brzostek T., Kinnunen J., Schwendimann R., Heinen M., Zikos D., Sjetne I.S., Smith H.L. & Kutney-Lee A. (2012) Patient safety, satisfaction and quality of hospital care: cross sectional surveys of nurses and patients in 12 countries in Europe and in the United States. *British Medical Journal* **344**, e1717. doi:10.1136/bmj.e1717

Aiken LH, Sloane DM, Bruyneel L, Van der Heede K & Sermeus W, RN4CAST Consortium (2013). Nurses' reports of working conditions and hospital quality of care in 12 countries in Europe. *International Journal of Nursing Studies* **50**(2),143–153.

Aiken LH, Sloane DM, Bruyneel L, Van der Heede K, Griffiths P, Busse R, Diomidous M, Kinnunen J, Kózka M, Lasaffre E, McHugh M, Moreno-Casbas MT, Rafferty AM, Schwendimann R, Scott PA, Tishelman C, Van Achterberg T & Sermeus W (2014) Nursing staffing and education and hospital mortality in nine European countries: a retrospective observational study. *Lancet* **383**, 1824–1830. doi.org/10.1016/S0140-6736(13)62631-8

Bae S.H. (2011) Assessing the relationships between nurse working conditions and patient outcomes: systematic literature review. *Journal of Nursing Management* **19**(6), 700–713.

Bai J., Hsu L. & Zhang Q. (2015) Validation of the Essentials of Magnetism II in Chinese critical care settings. *Nursing in Critical Care* **20**(3), 134–145.

Bruyneel L., Van den Heede K., Diya L., Aiken L. & Sermeus W. (2009) Predictive validity of the International Hospital Outcomes Study questionnaire: an RN4CAST pilot study. *International Journal of Nursing Scholarship* **41**, 202–210.

Cheung R.B., Aiken L.H., Clarke S.P. & Sloane D.M. (2008) Nursing care and patient outcomes: international evidence. *Enfermeria Clinica* **18**(1), 35–40.

De Brouwer B.J.M., Kaljouw M.J., Kramer M., Schmalenberg C. & Van Achterberg T. (2014) Measuring the nursing work environment: translation and psychometric evaluation of the Essentials of Magnetism. *International Nursing Review* **61**(1), 99–108.

De Vet H.C.W., Terwee C.B., Mokkink L.B. & Knol D.L. (2011) *Measurement in Medicine*. Cambridge University Press, A Practical Guide.

Djukic M., Kovner C.T., Brewer C.S., Fatehi F.K. & Cline D.D. (2013) Work environment factors other than staffing associated with nurses' ratings of patient care quality. *Health Care Management Review* **38**(2), 105–114.

Duvall J.J. & Andrews D.R. (2010) Using a structured review of the literature to identify key factors associated with the current nursing shortage. *Journal of Professional Nursing* **26**(5), 309–317.

Elbers R.G., Rietberg M.B., Van Wegen E.E.H., Verhoef J., Kramer S.F., Terwee C.B. & Kwakkel G. (2012) Self-report fatigue questionnaires in multiple sclerosis, Parkinson's disease and stroke: a systematic review of measurement properties. *Quality of Life Research* **21**(6), 925–944.

Karanikolos M., Mladovsky P., Cylus J., Thomson S., Basu S., Stuckler D., Machenbach J.P. & McKee M. (2013) Financial crisis, austerity and health in Europe. *Lancet* **381**, 1323–1331.

Kramer M. & Hafner L. (1989) Shared values: impact on staff nurse job satisfaction and perceived productivity. *Nursing Research* **38**(3), 172–177.

Kramer M. & Schmalenberg C. (2002) Staff nurses identify Essentials of Magnetism. In *Magnet Hospitals Revisited: Attraction and Retention of Professional Nurses*, (McClure M.L., Hinshaw A., eds), Silver Spring (MD), American Nursing Association, pp. 25–59.

Kramer M., Brewer B.B., Halfer D., Hnatiuk C.N., MacPhee M. & Schmalenberg C. (2014) The evolution and development of instrument to measure essential professional nursing practices. *Journal of Nursing Administration* **44**(11), 569–576.

Lake E.T. (2002) Development of the Practice Environment Scale of the nursing work index. *Research in Nursing & Health* **25**(3), 176–188.

Lake ET (2007) The nursing practice environment: measurement and evidence. *Medical Care Research and Review* **64**(2), 104SY122S.

McClure M.L., Poulin M.A., Sovie M.D. & Wandelt M.A. (1983) *Magnet hospitals attraction and retention of professional nurses* American Nurses' Association, Kansas City (MO).

Mokkink L., Terwee C.B., Patrick D., Alonso J., Stratford P., Knol D., Bouter L.M. & De Vet H.C. (2010) The COSMIN study reached international consensus on taxonomy, terminology and definitions of measurement properties for health-related patient-reported outcomes. *Journal of Clinical Epidemiology* **63**(7), 737–745.

Moos R.H. & Insel P.M. (1994) *A Social Climate Scale: Work Environmental Scale Manual*, 3rd edn. Consulting Psychologists Press Inc., Mountain View California.

Nolan M., Grant G., Brown J. & Nolan J. (1998) Assessing nurses' work environment: old dilemmas, new solutions. *Clinical Effectiveness in Nursing* **2**, 145–156.

Nunnally J.C. & Bernstein I.H. (1994) *Psychiatric Theory*. McGraw-Hill, New York.

Organisation for Economic Co-operation and Development (OECD). (2012). *Health at a Glance: Europe 2012*. OECD Publishing, Paris.

Schmalenberg C. & Kramer M. (2008) Essentials of a Productive Nurse Work Environment. *Nursing Research* **57**(1), 2–13.

Sermeus W., Aiken L.H., Van den Heede K., Rafferty A.M., Griffiths P., Moreno-Casbas M.T., Busse R., Lindqvist R., Scott A.P., Bruyneel L., Brzostek T., Kinnunen J., Schubert M., Schoonhoven L., Zikos D. & RN4CAST consortium. (2011) Nurse forecasting in Europe (RN4CAST): rationale, design and methodology. *Biomed Central Nursing* **10**, 6. doi:10.1186/1472-6955-10-6

Sims H.P Jr, Szilagyi H.P.A.D. & Keller R.T. (1976) The measurement of job characteristics. *The Academy of Management Journal* **19**(2), 195–212.

Terwee C.B., Bot S.D.M., De Boer M.R., Van der Windt D.A.W.M., Knol D.L., Dekker J., Bouter L.M. & De Vet H.C.W. (2007) Quality criteria were proposed for measurement properties of health status questionnaires. *Journal of Clinical Epidemiology* **60**(1), 34–42.

Van Bogaert P., Clarke S., Vermeyen K., Meulemans H. & Van de Heyninge P. (2009) Practice environments and their associations with nurse-reported outcomes in Belgian hospitals: development and preliminary validation of a Dutch adaptation of the revised nursing work index. *International Journal of Nursing Studies* **46** (1), 54–64.

Warshawsky N.E. & Havens D.S. (2011) Global use of the Practice Environment Scale of the nursing work index. *Nursing Research* **60**(1), 17–31.

Whitley M.P. & Putzier D.J. (1994) Measuring nurses' satisfaction with the quality of their work and work environment. *Journal of Nursing Care Quality* **8**(3), 43–51.

Zangaro G.A. & Soeken K.L. (2007) A meta-analysis of studies of nurses' job satisfaction. *Research in Nursing Health* **30**(4), 445–458.